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# Currency Substitution and Instability in the World Dollar Standard

*By* RONALD I. MCKINNON*

Should foreign exchange considerations or observed growth in the money supplies of other industrial countries significantly influence the domestic monetary policy of the United States? The received wisdom of both monetarist and Keynesian economists and the revealed preferences of U.S. policymakers has been to try—often unsuccessfully—either to suppress international influences or to ignore them. Both groups define policy targets in terms of growth rates in purely *domestic* monetary aggregates, or in terms of domestic (dollar) rates of interest.

Indeed one of the main objectives of Milton Friedman's persuasive advocacy (1953) of floating exchange rates was to secure, without the use of exchange controls or other trade distortions, national monetary autonomy for all countries—whether they be the United States, Germany, Canada, or Brazil. This point of view has been vigorously espoused by both Keynesians such as James Meade (1955) and monetarists such as Harry Johnson (1972); it was influential in persuading policymakers to accept (albeit under pressure) and advent of floating exchange rates among industrial countries in 1973—followed by formal legal ratification through amendment of the IMF's Articles of Agreement in 1976. And monetarists have a strategy for exercising this autonomy: each country pursues its own fixed monetary growth rule as if the demands for national monies were stable and independent of one another.

In contrast, the admittedly casual empirical evidence presented below suggest a radically different view: the national (convertible) monies of an inner group of industrial countries are highly substitutable in demand according to anticipated exchange-rate movements. This international currency substitution destabilizes the demand for individual national monies so that one can't make much sense out of year-to-year changes in purely national monetary aggregates in explaining cycles in purely national rates of price inflation.

However, all is not necessarily lost for the monetarist view. The world demand for money seems relatively stable. By considering a crude index of a "world" money supply (confined to the convertible currencies of industrial countries), the two great outbreaks of international price inflation in the 1970's become explicable. The world money supply exploded in 1971–72 and again in 1977–78 (well before the two oil crises of 1973 and 1979). Speculation against the U.S. dollar was combined with exchange interventions by foreign central banks (to prevent the dollar from falling) that directly expanded money supplies in Europe and Japan. How this inflationary pressure was divided among countries depended on relative exchange-rate movements in each case, but the impact on the world price level was unambiguous. Even for the United States itself, this tentative measure of changes in the world money supply explains the great (dollar) price inflations of 1973–74 and 1979–80 much better than does any domestic American monetary aggregate.

But why didn't the American money supply decrease as people shifted out of dollars into foreign monies? First, the American monetary authorities were operating myopically under a fixed domestic money growth rule over a monthly or quarterly time horizon. Secondly, in the very short run, the U.S. money stock did not contract automatically in response to official exchange intervention. Because the United States is the reserve-center country under the world dollar stan-

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dard, even massive dollar interventions by foreign central banks are usually sterilized of any impact on the American monetary base —as described in the theoretical model given below.

But the sterilization appropriate for the strong dollar standard under the fixed exchange rates of the 1950's and 1960's is less benign under today's managed floating and volatile exchange rate expectations. I conclude by briefly discussing how American monetary policy should be suitably "internationalized" in order to better stabilize both the international and American price levels.

## I. The Evidence

The usual procedure would be to present an ostensibly complete structural model of the international macroeconomy, and then estimate the individual parameters by using elaborate econometric techniques only loosely related to the theoretical model. The nature and quality of the data would not be discussed, but the unprocessed statistical series might be available from the author upon special request.

Here, I follow a different strategy. First unprocessed but standardized data on the industrial countries' national money supplies, price levels, and foreign exchange reserves are compiled from the *International Financial Statistics* of the International Monetary Fund (IMF). Without trying to build a comprehensive model of income, employment, or price levels in the world economy, two extreme cases where international currency substitution seemed to lead to a loss of monetary control are identified. Then a very short-run and highly simplified analytical model is developed to explain what happened in those two episodes and, possibly, in other less easily identified cases.

The money supplies, whose rates of change appear in Table 1, are defined narrowly to include currency and mainly non-interest-bearing checking accounts—although some countries do include deposits bearing fixed rates of interest in this "$M_1$" category. Precisely which of these convertible currencies are the strongest substitutes for one another, and which should enter with the heaviest weights in any index of world money, is not addressed. Nevertheless, Table 1 includes the principal monies that are used for invoicing world trade and for denominating internationally liquid wealth in the Euromarkets. But Eurocurrency deposits per se are omitted because they are more like bonds in bearing an equilibrium market rate of interest and in not being usable by nonbanks for making payments to third parties (Helmut Mayer, 1979). In short, I am interested in a narrow definition of money in the spectrum of financial assets, but one which has effective potential as an international medium of exchange and standard of value.

Annual percentage growth rates in the nominal money supplies of the ten industrial countries in Table 1 are then averaged using weights corresponding to their nominal *GNP* in 1970—the last year of more or less fixed exchange rates and the midpoint of my 20-year data series. This aggregation procedure for measuring the growth in world money neatly avoids incorporating continual exchange rate fluctuations, (Harold Van Cleveland and Bruce Brittain, 1976), and ignores national differences in *GNP* growth and in growth in real money stocks. The United States enters with a heavy unchanging weight of .5174. More importantly, no econometric attempt is made to distinguish the international moneyness of, say, the Italian lire from that of the German mark.

Nevertheless, the weighted average of world money growth appearing in the right-hand column of Table 1—with a trend rate of about 8 percent per year—clearly reveals the monetary consequences of the two major episodes of "bear" speculation against the dollar:

1) 1971–72: the anticipated collapse of official dollar parities under the Bretton Woods and then the Smithsonian agreements; and

2) 1977–78: the attempt by officials in the Carter Administration to talk the dollar down, culminating in the massive stabilization program of November 1, 1978.[1]

[1]This unfortunate official perception that the dollar was overvalued was based on an emerging U.S. trade deficit in 1977. However, one can explain (see my 1981

TABLE 1—WORLD MONEY SUPPLY INCREASES: TEN INDUSTRIAL COUNTRIES
(Percentage changes between year-end stocks)

| | U.S. | Canada | Japan | U.K. | Germany | France | Italy | Nether-lands | Belgium | Switzer-land | Weighted World Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (*GNP* weights 1970) | (.5174) | (.0432) | (.1042) | (.0648) | (.0989) | (.0804) | (.0491) | (.0167) | (.0137) | (.0115) | |
| 1960 | 0.6 | 4.0 | 36.6 | 0.4 | 7.2 | 14.1 | 13.6 | 6.7 | 1.9 | 5.0[a] | 7.03 |
| 1961 | 3.3 | 12.7 | 18.4 | 2.0 | 14.5 | 15.5 | 16.0 | 7.7 | 7.7 | 15.3 | 8.18 |
| 1962 | 2.5 | 4.3 | 16.6 | −5.0 | 6.8 | 18.1 | 17.6 | 7.5 | 7.2 | 11.3 | 6.23 |
| 1963 | 3.2 | 7.3 | 34.6 | 14.5 | 7.2 | 14.5 | 13.6 | 9.3 | 9.6 | 7.3 | 9.43 |
| 1964 | 4.7 | 9.4 | 13.0 | 3.2 | 8.5 | 8.3 | 7.5 | 8.0 | 6.6 | 6.5 | 6.57 |
| 1965 | 4.8 | 14.3 | 18.2 | 3.9 | 7.7 | 9.4 | 16.4 | 10.0 | 7.1 | 3.8 | 7.88 |
| 1966 | 2.4 | 7.3 | 13.9 | 0.0 | 1.9 | 7.8 | 13.3 | 6.8 | 6.6 | 3.8 | 4.72 |
| 1967 | 7.5 | 4.0[a] | 14.1 | 7.6 | 10.0 | 4.8 | 15.7 | 6.2 | 3.2 | 6.7 | 8.38 |
| 1968 | 8.1 | 0.6 | 13.3 | 3.9 | 7.6[a] | 8.0 | 11.9 | 11.4 | 7.2 | 11.9 | 8.26 |
| 1969 | 3.3 | −4.2 | 20.6 | 0.0 | 5.3 | −2.5 | 15.9 | 8.1 | −6.0 | 11.0 | 4.96 |
| 1970 | 4.3 | 1.8 | 16.8 | 9.3 | 8.6 | 11.4 | 27.4 | 11.8 | 7.0 | 11.0 | 8.19 |
| 1971 | 6.5 | 13.1 | 29.7 | 15.2 | 12.8 | 11.8 | 19.0 | 15.0 | 11.1 | 18.4 | 11.77 |
| 1972 | 9.1 | 12.2 | 24.7 | 14.0 | 14.1 | 14.9 | 17.3 | 17.6 | 15.2 | 5.7 | 12.73 |
| 1973 | 5.7 | 8.8 | 16.8 | 5.1 | 1.7 | 9.8 | 24.3 | 0.0 | 7.5 | 0.0 | 7.65 |
| 1974 | 3.0 | 1.5 | 11.5 | 10.8 | 10.7 | 15.2 | 9.4 | 12.2 | 6.2 | −3.3 | 6.51 |
| 1975 | 5.5 | 19.0 | 11.1 | 11.0[a] | 14.3 | 12.6 | 13.4 | 19.7 | 15.7 | 4.4 | 9.22 |
| 1976 | 5.9 | 1.5 | 12.5 | 11.3 | 3.3 | 7.5 | 18.8 | 8.2 | 7.0 | 10.5 | 7.36 |
| 1977 | 8.2 | 10.4 | 8.2 | 21.5 | 12.0 | 9.3[a] | 21.4 | 13.2 | 8.3 | 0.6 | 10.27 |
| 1978 | 8.2 | 7.0 | 13.4 | 16.4 | 14.2 | 11.1 | 26.6 | 4.1 | 5.9 | 19.7 | 10.98 |
| 1979 | 8.0 | 1.4 | 3.0 | 9.1 | 3.2 | 11.9 | 23.7 | 2.8 | 2.5 | −1.3 | 7.60 |
| 1980 | 5.3 | 10.7 | −2.1 | 3.9 | 4.0 | 6.4 | 12.9 | 6.0 | 0.3 | −0.5 | 4.88 |

*Source*: All data are noninterest bearing $M_1$ and are taken from line 34 of the *International Financial Statistics*: 1975–80 data from the February 1982 issue, and 1960–74 data from the 1981 yearbook.
[a]Implies a discontinuous series where arbitrary averaging was used.

During both these major episodes (and in a host of minor ones), foreign central banks were heavily intervening—but to varying degrees—to prevent their currencies from appreciating against the dollar. Because of passive sterilization by the Federal Reserve (as explained below), the American money supply was undiminished even as foreign money supplies rose substantially above their trends. Thus, the world money supply rose unusually rapidly to between 10 and 13 percent per year in 1971–72 and again in 1977–78: the far right column in Table 1.

These international losses of monetary control were followed—with lags of uncertain duration—by inflationary explosions in 1973–74 and 1979–80, as one can see from the price level data in Table 2. Using the same 1970 *GNP* weights, one can aggregate wholesale price levels internationally to get a weighted world average price index in the right-hand column of Table 2. In measuring international inflationary pressure, wholesale indices come closer than consumer price indices to providing a common denominator of tradable goods.

Were foreign exchange interventions responsible for this loss of monetary control? Those increases in the (gross) foreign exchange reserves of different countries that are associated with increases in their domestic monetary bases are hard to identify. Table 3 presents data on the direct dollar liabilities of the U.S. government—almost all in the form of U.S. Treasury bonds and bills—to the governments of Canada, Japan, and

article) the deficit on fiscal grounds rather than an exchange rate or price level disalignment. The initial tendency for the dollar to fall led to a loss of monetary control in the United States, and a much bigger dollar devaluation than the authorities wanted.

TABLE 2—WORLD PRICE INFLATION: TEN INDUSTRIAL COUNTRIES
(Percentage changes from past year's period average)

| | U.S. | Canada | Japan | U.K. | Germany | France | Italy | Nether-lands | Belgium | Switzer-land | Weighted World Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (*GNP* weights 1970) | (.5174) | (.0432) | (.1042) | (.0648) | (.0980) | (.0804) | (.0491) | (.0167) | (.0137) | (.0115) | |
| 1960 | 0.1 | 0.1 | 0.1 | 1.3[a] | 1.1 | 3.6[c] | 0.9 | −2.5[d] | 1.1 | 0.6[d] | 0.6 |
| 1961 | −0.4 | 1.1 | 0.1 | 3.8 | 1.5 | 3.0 | 0.1 | −1.2 | −0.1 | 0.2 | .5 |
| 1962 | 0.2 | 2.8 | −1.6 | 2.1 | 3.5 | 0.5 | 3.1 | 1.2 | 0.7 | 3.5 | .7 |
| 1963 | −0.4 | 1.9 | 1.7 | 1.2 | 0.4 | 2.8 | 5.3 | 2.5 | 2.5 | 3.8 | .8 |
| 1964 | 0.2 | 0.4 | 0.2 | 2.9 | 1.1 | 3.6 | 3.2 | 6.2 | 4.7 | 1.3 | 1.1 |
| 1965 | 1.3 | 2.1 | 0.7 | 3.7 | 2.4 | 0.7 | 1.6 | 3.5 | 1.0 | 0.5 | 1.5 |
| 1966 | 3.3 | 3.5 | 2.4 | 2.8 | 1.8 | 2.7 | 1.6 | 4.5 | 0.6 | 1.9 | 2.9 |
| 1967 | .2 | 1.8 | 1.8 | 1.2 | −1.0 | −0.9 | −0.1 | 0.0 | 0.0 | 0.3 | .3 |
| 1968 | 2.4 | 2.2 | 0.9 | 3.9 | −0.7 | 1.7 | 0.3 | 1.1 | 1.2 | 0.1 | 1.5 |
| 1969 | 4.0 | 4.7 | 2.1 | 3.4 | 1.8 | 10.7 | 3.9 | 0.0 | 3.4 | 2.9 | 4.0 |
| 1970 | 3.6 | 1.4 | 3.6 | 7.1 | 4.9 | 7.5 | 7.3 | 6.4 | 6.0 | 4.1 | 4.4 |
| 1971 | 3.3 | 1.2 | −0.8 | 9.0 | 4.3 | 2.1 | 3.4 | 1.0 | 1.9 | 2.2 | 3.1 |
| 1972 | 4.5 | 7.0 | 0.8 | 5.3 | 2.6 | 4.6 | 4.1 | 4.0 | 4.1 | 3.6 | 4.1 |
| 1973 | 13.1 | 21.5 | 15.9 | 7.3 | 6.6 | 14.7 | 17.0 | 12.4 | 7.4 | 10.7 | 12.9 |
| 1974 | 18.9 | 22.1 | 31.3 | 23.4 | 13.4 | 29.2 | 40.7 | 13.6 | 20.1 | 16.2 | 21.9 |
| 1975 | 9.2 | 6.7 | 3.0 | 24.1 | 4.7 | −6.1 | 8.5 | 7.5[e] | 4.5 | −2.3 | 7.5 |
| 1976 | 4.6 | 5.1[a] | 5.0 | 17.3 | 3.7[b] | 7.4 | 23.8 | 7.8 | 7.1 | −0.7 | 6.6 |
| 1977 | 6.1 | 7.9 | 1.9 | 19.8 | 2.7 | 5.6 | 16.6 | 5.8 | 2.4 | 0.3 | 6.6 |
| 1978 | 7.8 | 9.3 | −2.5 | 9.1 | 1.2 | 4.3 | 8.4 | 1.3 | −2.0 | −3.4 | 5.6 |
| 1979 | 12.5 | 14.4 | 7.3 | 12.2 | 4.8 | 13.3 | 15.5 | 2.7 | 6.3 | 3.8 | 11.1 |
| 1980 | 14.0 | 13.4 | 17.9 | 16.3 | 7.5 | 8.8 | 20.1 | 8.2 | 5.8 | 5.2 | 13.5 |

*Source*: All data are wholesale price indices from *International Financial Statistics* (various issues), line 63.
[a]Series based on industrial output prices.
[b]New series based on industrial product prices.
[c]Series based on industrial goods prices (tax included).
[d]Series based on home and import goods prices.
[e]New series based on final product prices.

Western Europe. (Rather arbitrary valuation changes in monetary gold stocks have nothing to do with foreign exchange intervention, and the physical quantities of gold held by industrial countries have been relatively stationary. Hence gold positions as well as Special Drawing Rights are ignored in Table 3.) Because the industrial countries (unlike *LDC*s) tend *not* to diversify their official reserves into Eurodollar deposits or foreign exchange assets other than dollars, the build-up of direct dollar claims on the U.S. government is a good approximation of their cumulative intervention in the foreign exchanges. Of course, under the asymmetrical world dollar standard, the U.S. government itself has negligible net accumulations of foreign exchange reserves.

Fortunately, in interpreting the crude data in Table 3, the very sharp run-ups of foreign exchange reserves by Western Europe and Japan in 1970–72 and 1977–78 are so striking that one need not quibble about whether or not direct dollar claims on the United States are an inclusive measure of foreign exchange intervention. From virtually zero growth in the 1960's, the rate of foreign exchange accumulation rose to about 70 percent per year in 1970–72. After another quiescent period of zero growth, foreign exchange accumulation again rose to about 40 percent per year in 1977–78—before falling back to zero net growth. These marked increases in foreign reserves are sufficient to explain the sharp increases in money supplies in Europe and Japan that dominated

TABLE 3—DOLLAR LIABILITIES OF THE UNITED STATES GOVERNMENT TO FOREIGN CENTRAL BANKS AND OFFICIAL AGENCIES
(In billions of U.S. dollars; year-end stocks)

| | Canada[a] (1) | Japan[c] (2) | Western[b] Europe (3) | Total (1) to (3) | Annual Percentage Change (5) |
|---|---|---|---|---|---|
| 1963 | 1.79 | 1.59 | 8.51 | 11.89 | |
| 1964 | 1.81 | 1.50 | 9.32 | 12.63 | +6.2 |
| 1965 | 1.70 | 1.57 | 8.83 | 12.10 | −4.4 |
| 1966 | 1.33 | 1.47 | 7.77 | 10.57 | −14.5 |
| 1967 | 1.31 | 1.45 | 10.32 | 13.08 | +23.7 |
| 1968 | 1.87 | 2.26 | 8.06 | 12.19 | −7.3 |
| 1969 | 1.62 | 2.61 | 7.07 | 11.30 | −7.9 |
| 1970 | 2.95 | 3.19 | 13.61 | 19.75 | +74.8 |
| 1971 | 3.98 | 13.78 | 30.13 | 47.89 | +142.0 |
| 1972 | 4.25 | 16.48 | 34.20 | 54.93 | +14.7 |
| 1973 | 3.85 | 10.20 | 45.76 | 59.81 | +8.9 |
| 1974 | 3.66 | 11.35 | 44.33 | 59.34 | −0.8 |
| 1975 | 3.13 | 10.63 | 45.70 | 59.46 | +0.2 |
| 1976 | 3.41 | 13.88 | 45.88 | 63.17 | +6.2 |
| 1977 | 2.33 | 20.13 | 70.75 | 93.21 | +47.6 |
| 1978 | 2.49 | 28.90 | 93.09 | 124.48 | +33.5 |
| 1979 | 1.90 | 16.36 | 85.60 | 103.86 | −19.9 |
| 1980 | 1.56 | 21.56 | 81.59 | 104.71 | +0.8 |

*Source*: All data from *International Financial Statistics*.
[a]Line 4aad, *IFS* (United States).
[b]Line 4abd, *IFS* (United States).
[c]Because direct U.S. liabilities to the Japanese government were not available, the virtually identical series on total Japanese reserves in foreign currency was used—line 1 d.d, *IFS* (Japan).

world money growth in 1971–72 and 1977–78, as portrayed in Table 1.

To be consistent with the idea of a stable aggregate demand for "world money," the resulting world price inflation—after a one- or two-year lag—should be quite general in 1973–74 and again in 1979–80 as seems to be true in Table 2. By comparison, individual rates of growth in national money supplies are—by themselves—quite puzzling as explanations of national inflation rates. For example, in 1978 Switzerland's money growth was 19.7 percent and the American money growth was "only" 8.2 percent; yet the United States experienced price inflation at about 13 percent in 1979–80, whereas Switzerland's rate was only about 4.5 percent. *In general, growth in the world money supply is a better predictor of American price inflation than is U.S. money growth.* Switzerland avoided the same inflationary pressure by letting its currency appreciate.

While not conclusive, the data are at least consistent with the idea that national monies are substitutable to the extent of making national money demand functions appear quite unstable if foreign exchange considerations are ignored. In the 1980's, it seems highly questionable for even the center country, the United States, to pursue a purely nationalistic monetary rule irrespective of whether money supplies of other convertible currency countries were sharply expanding or contracting—or irrespective of whether the dollar was falling or rising in the foreign exchange market.

## II. A Model of the World Demand for Money

Following Alexander Swoboda (1978), consider only two countries: the United States issues dollars and the rest of the world (*ROW*) issues a single convertible currency called *rowa*. The *ROW* is an analytical ab-

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straction only for industrial countries other than the United States. However, demand for either of these two non-interest-bearing monies could well originate, in part, with third countries whose own currencies are inconvertible and which are not formally part of the analysis. Nevertheless, dollars are mainly demanded for monetary circulation in the United States, and *rowa* for monetary circulation in *ROW*. The margin of substitutability between the two remains to be described.

A complete picture of international inflation would link money creation to realized price and possibly output increases—with differing variable lags. Such a complex process cannot be captured within a simple analytical framework. Focus instead on the much narrower problem of how changing exchange-rate expectations immediately influence the demand for *rowa* relative to dollars and the total supply of world money. In analyzing these monetary disturbances in the very short run, assume that national price levels, real incomes, and the spot exchange rate are all given. Fixing the spot exchange rate between dollars and *rowa* roughly reflects the current propensity of *ROW* government to intervene by "leaning against the wind" to prevent any immediate sharp changes. (Prior to 1973, it would have represented an attempt to maintain an official parity.) This presumed short-run stability in the spot exchange rate under managed floating allows us to aggregate the two national money stocks, and define the world's nominal money stock, $M^w$, to be

$$(1) \qquad M^w = M + SM^*,$$

where $M$ is U.S. money stock (dollars), $M^*$ is *ROW* money stock (*rowa*), and $S$ is dollars/*rowa*.

Although the spot exchange rate is stable within a very short time horizon of a few days, private expectations of future exchange-rate movements may be quite volatile from time to time. Let $s$ represent the expected change in $S$, averaged into the near future of "several weeks." The parameter $s$ is equal to the discount on the dollar in the forward exchange market, which reflects anticipated dollar depreciation,

$$(2) \qquad s = E\{dS/dt\} = (F - S)/S,$$

where $F$ is the forward exchange rate.

Fluctuations in $s$ are given *exogenously* to the model. They may reflect pure foreign exchange disturbances as when the American Treasury Secretary suggested early in 1977 that the dollar was overvalued; or they may vary simultaneously with changing assessments of future American monetary policy vis-à-vis *ROW* monetary policy. Indeed, historical evidence suggests that exchange-rate movements (beyond the very short-run official commitment to managed floating) are highly sensitive to perceived or actual changes in monetary policy (Peter Bernholz, 1981). Without spelling out all the mechanisms by which $s$ could change, the analysis begins rather arbitrarily with an expectations shock in the form of a discrete change in $s$.

### A. *Perfect Capital Mobility*

With free Euromarkets and the absence of sustained exchange controls that separate national markets in interest-bearing securities, for analytical purposes suppose the international bond market is "perfect." After taking expected exchange rate changes, $s$, into account, investors are indifferent between investing in short-term dollar or *rowa* bonds. Define this common nominal world yield on bonds to be $i^w$: the opportunity cost of holding money in the demand function for world money.[2]

$$(3) \qquad M_d^w/P = L(i^w, Y^w),$$

where $Y^w = Y + Y^*$ is given world income, and $P$ is the given world price level.

With $P$ and $Y^w$ given in the very short run, the demand function describes how $i^w$ must vary to accommodate any changes in the world's money supply. The function $L$

[2] Throughout the analysis, the subscript $d$ represents demand. The $M_d^w$ is the *ex ante* world money demanded at the going interest rate, where $M^w$ is the actual stock of world money in existence.

describes Keynesian liquidity preference on a global scale.

As a first approximation, we shall ignore any direct effect that changes in $s$ might have on $i^w$ or on the *world* demand for money. This would require a more complete macromodel specifying how $s$ influences expected world price inflation. Hence $s$ does not appear in world money demand—equation (3). But $s$ directly affects individual money demands and the rates of interest on dollar bonds and on *rowa* bonds. Assume that

$$i = i^w + (1-\alpha)s \tag{4}$$

$$i^* = i^w - \alpha s \tag{5}$$

where (4) is interest rate on dollar bonds and (5) is interest rate on *rowa* bonds.

Suppose $\alpha = B/B^w$ is the financial weight of the United States in the world capital markets as measured by the (given) ratio of dollar to total bonds outstanding. For the single term to maturity in equation (4), a rise in $s$ (the expected dollar depreciation) will force up the dollar rate of interest by $(1-\alpha)s$. In the 1950's and early 1960's, during the "strong" dollar standard and American financial predominance, $\alpha$ was likely close to unity: as $\alpha \to 1$, $i \to i^w$ for any given $s$. The interest rate on dollar bonds dominates our hypothetical world rate of interest, and changes in $s$ have a negligible impact on interest rates in the American money market.

In the 1980's, on the other hand, the financial importance of the United States in the world's bond market has been reduced so that $\alpha$ may be closer to, say, one-half. In this latter case, an increase is $s$ leads to a more symmetrical adjustment: the (short-term) rate of interest on dollar bonds is forced up by $s/2$ and that on *rowa* bonds is forced down by $s/2$. In this more symmetrical situation, nominal rates of interest in U.S. money markets are no longer determined solely by domestic influences. The dollar rates of interest on federal funds or U.S. Treasury bills become even more treacherous as short-run indicators of monetary ease or tightness.

Finally, consider two strong implications of the perfect capital mobility assumption embedded in equations (4) and (5):

$$i - i^* = s \tag{6}$$

(Fisher Open Condition)

$$i^w = \alpha i + (1-\alpha)i^* \tag{7}$$

(Integrated Capital Market)

The short-term interest differential accurately reflects expected exchange-rate movements, and the world interest rate is simply a weighted average of the two national interest rates. Clearly, these are very strong implications of the perfect capital markets assumption, and this dominance of the foreign exchanges in domestic interest rate determination may not be valid during much of the 1960–80 period. Nevertheless, in the two extreme episodes of 1971–72 and 1977–78 when expectations of dollar depreciation were highly developed, this simplifying assumption gives insight into how currency substitution actually occurred and is consistent with interest-rate movements actually observed (see my 1981 article).

### B. *A Two-Stage Money Demand Function*

This consistent weighting of the United States and *ROW* in the international bond market makes the world demand for money independent of $s$. However, the *distribution* of demand between dollars and *rowa*, for any given $M_d^w$, will be highly sensitive to expected changes in the exchange rate. Let $\beta$ be the dollar share of world money such that

$$M_d = \beta(s; Y/Y^w)M_d^w, \tag{8}$$

$$SM_d^* = (1-\beta)M_d^w, \tag{9}$$

where (8) is demand for dollars and (9) is demand for *rowa*.

In effect we have a two-stage money demand function. The first stage—equation (3)—describes the world demand for money, and the second stage—equations (8) and (9)—divides that demand between the two currencies. In the short run, the share of dollars in $M_d^w$ declines with $s$ and the share of *rowa* increases commensurately so as to keep the total demand for world money constant for

any given world interest rate. Hence $\partial\beta/\partial s < 0$ is a convenient measure of pure *currency substitution* between dollars and *rowa*. On the other hand, in the short run, $\alpha$ is insensitive to $s$ because interest rates on bonds adjust to compensate their owners.

The first channel through which an increase in $s$ raises $M_d^*$ and reduces $M_d$ is when large commercial banks, and possibly some nonfinancial multinationals, shift their non-interest-bearing working balances from dollars into *rowa* to reduce direct losses from anticipated dollar devaluation. Ordinarily, a rather small proportion of each country's non-interest-bearing money stock would be owned by such trade-oriented institutions. Hence this direct form of currency substitution, Channel One, may well be significant without being dominant.[3]

Instead, the indirect route, Channel Two, which utilizes our strong assumption of perfect mobility in the international bond market, is likely to lead to greater substitution between the two monies and to create a larger capital outflow from the United States. Let us take a simple example. In a situation where $\alpha = 1/2$, suppose $s$ increases from zero to 6 percent because the American Secretary of the Treasury opines that the dollar is overvalued. The "perfect" international bond market quickly adjusts to these new exchange-rate expectations: the incipient arbitrage pressure to move out of dollar bonds into *rowa* bonds causes interest rates to adjust immediately: $i$ rises by three percentage points, and $i^*$ falls by three percentage points. At this stage, significant capital outflows need not occur if expectations are commonly held, and interest rates adjust immediately so as to eliminate the incentives for profiting from international arbitrage in interest-bearing securities.[4]

Currency substitution induced by these interest-rate changes occurs indirectly. American transactors naturally try to sell non-interest-bearing dollar cash balances and buy dollar bonds when $i$ jumps upward by three percentage points—and foreign transactors sell *rowa* bonds and buy *rowa* cash balances. But this arbitrage from money to bonds tends to decrease $i$ and increase $i^*$ so as to reduce $i - i^*$ below $s$, thus creating temporary pressure in the international bond market. In our example, the interest differential falls incipiently below six percentage points. Then international bond arbitragers do the rest: they sell dollar bonds and buy *rowa* bonds to preserve $i - i^* = s$. This additional capital outflow from the United States is exactly equal to the reduced demand for dollar cash balances and to the augmented demand for *rowa* cash balances. Because most domestic transactors (money owners) in the United States and in *ROW* are influenced by these interest-rate changes, this indirect form of currency substitution may well be the most important quantitatively. *Massive capital flows can easily be induced even when the interest differential remains "correctly" aligned to reflect accurately the change in expected exchange depreciation.*

Throughout the above analysis of money demands, I have assumed that the authorities maintain the spot exchange rate at $S$. Indeed, this provided part of the analytical basis for our world money demand function—equation (3). The next step is to look more explicitly at the short-run supply mechanism arising out of this foreign exchange intervention.

### III. The Supply of International Money

The supply of world money is under the joint control of the U.S. Federal Reserve System and *ROW* bank, which is the single

[3] Bruce Brittain (1981) provides some independent evidence that the velocities of money in Germany and the United States are inversely related according to the interest differential between dollar and D.M. bonds. Marc Miles (1978) concludes that currency substitution exists between Canada and the United States also based on the interest differential that incorporates expected changes in exchange rates. Whereas Arturo Brillembourg and Susan Schadler (1979) compute semielasticities of substitution between the dollar and a number of other currencies.

[4] Notice that the forward discount on the dollar would instantaneously go to 6 percent to match the interest differential. Our assumption of perfect capital mobility eliminates the need to consider the forward market separately.

hypothetical central bank representing the other convertible currencies. Because the United States is the reserve center, only the *ROW* bank directly enters the foreign exchange market to smooth the spot exchange rate, $S$. How such intervention may, in turn, influence the money supply (monetary base) of either country is important to spell out—as has been done by Lance Girton and Dale Henderson (1976), Robert Heller (1976), Swoboda (1978), and Richard Marston (1980). However, none of these authors has focused on my main theme: how currency substitution potentially destabilizes the world's money supply even when the world's aggregate demand for money is stable.

For simplicity, I ignore fractional reserve banking and the separate existence of commercial banks: at this level of abstraction no significant conclusions would change from building them into the model. Hence, the *rowa* component, $M^*$, of the world's money supply held by nonbanks is simply direct claims on *ROW* bank; and $M$ is dollar claims of nonbanks on the Federal Reserve. The sum of these central bank liabilities is world money as defined by equation (1).

Reflecting the workings of the international dollar standard, (10) is a simple balance sheet equation showing both the domestic and foreign assets upon which *ROW* bank expands the *rowa* money supply:

$$M^* \equiv A^* + M_r/S + B_r/S, \tag{10}$$

where $A^*$ is domestic (*rowa*) assets, $M_r$ is dollar deposits with the Fed, and $B_r$ is U.S. Treasury bonds.

Equation (11) is the balance sheet identity showing the assets and liabilities of the Federal Reserve System:

$$M + M_r \equiv A, \tag{11}$$

where $A$ is domestic (dollar) assets.

From (10) and (11), the world's monetary base is simply the sum of domestic assets held by each central bank plus nonmonetary U.S. Treasury bonds held by *ROW* bank.

$$M + SM^* = M^w = A + SA^* + B_r. \tag{12}$$

The important asymmetry in the world system hinges on how *ROW* bank (with the concurrence of the Fed) chooses to hold its dollar reserves. If as a result of foreign exchange intervention, *ROW* bank purchases U.S. Treasury bonds $B_r$ in the open market, then the world money supply increases—according to equation (12)—as long as the domestic asset positions of each central bank are fixed. This closely corresponds to actual practice as shown by foreign holdings of U.S. Treasury bonds in Table 3. However, if *ROW* bank chooses to build up and hold direct depository claims on the Fed, $M_r$, the world's money supply would remain unchanged because the reduction in dollar holdings by nonbanks (the dollar money supply) is offset by a rise in the *rowa* money supply. How *ROW* bank holds its dollar reserves is important, and the consequences of each alternative are explored below.

### A. *The Nonsterilization of Exchange Interventions*

If a central bank purchases foreign exchange, the domestic monetary base initially expands and the foreign monetary base potentially contracts. Under the present system of managed floating, should governments remain free to influence their exchange rates directly without accepting these immediate monetary consequences? Central banks often take offsetting actions—through open-market operations, changed reserve requirements, or rediscounting—to sterilize the domestic monetary impact of these official interventions.

Within its own simple model of the world dollar standard, *ROW* bank would have to consciously contract its domestic assets in order to sterilize the influence of a buildup in its foreign assets. Clearly, sterilization would make it much more difficult for *ROW* bank to meet its exchange-rate target. Moreover, Hans Genberg and Swoboda (1981) provide evidence that when sterilization occurs in Europe and elsewhere, it is only partial. Hence, let us assume for analytical purposes that *ROW* bank does not sterilize: $A^*$ is constant as foreign exchange intervention takes place.



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To impose a nonsterilization rule on the Federal Reserve System (in response to *ROW* bank's interventions) requires more than keeping domestic assets $A$ constant—or on a predetermined Friedman growth path. Dollar claims accumulated by *ROW* bank should be allowed to contract the American money supply in the hands of the nonbank public. And having *ROW* bank build up dollar claims $M_r$—perhaps interest bearing—on the Federal Reserve System would be the simplest technique. Although in practice, the direct deposits of foreign central banks with the Fed are only transitory, let us provisionally assume that *ROW* bank holds all its exchange reserves in this form, that is, assume that $B_r = 0$ and $M_r > 0$.

What then are the monetary consequences of discretionary shifts in either central bank's domestic asset position ($A$ or $A^*$) or in exogenous changes in the relative attractiveness of dollars versus *rowa* as denoted by the parameter $s$? From equation (12) and the assumption that $B_r = 0$, the relevant money multipliers are

$$(13) \quad dM^w/dA = dM^w/d(SA^*) = 1,$$

and $$dM^w/ds = 0.$$

By varying its domestic assets by one dollar, each central bank has exactly the same impact on the world's money supply: one dollar. From our world money demand function, equation (3), each has an equal impact on the world rate of interest, $i^w$. In addition, the world's money supply is independent of $s$—any changes in the expected rate of dollar devaluation. The nonsterilization procedure prevents flights from one currency to another from upsetting the world's stock of money—while allowing the authorities to automatically track this changing demand for each national money. This last result can easily be seen by computing the multiplier effect of a change in $s$ for each national currency:

$$(14) \quad dM/ds = (d\beta/ds)M^w = -\Delta M_r < 0.$$

The stock of dollars changes according to our currency substitution parameter $d\beta/ds$ weighted by the world's money stock: a change which in turn is equal to the international flow of capital, $\Delta M_r$. The American money stock changes dollar for dollar according to the reduced demand for it—neither more nor less. Similarly, the stock of *rowa* increases symmetrically by as much as the stock of dollars decreases.

$$(15) \quad dM^*/ds = (d\beta/ds)M^w/S = \Delta M_r/S > 0.$$

In response to open-market operations in domestic assets by either central bank, the individual money multipliers are:

$$(16) \quad dM/dA = dM/d(SA^*) = \beta(s);$$

$$(17) \quad dM^*/d(A/S) = dM^*/dA^* = 1-\beta(s).$$

*Domestic* credit expansion by either central bank has exactly the same effect on national money supplies, as well as on the world money supply. However, when $A$ increases, capital flows out of the United States by $(1-\beta)\Delta A$, and when $A^*$ increases, capital flows into the United States by $\beta A^*$. The $M_r$ adjusts by the amount of each capital flow.

What room then does our stabilizing rule of no sterilization leave for discretionary monetary policy on the part of our two countries? Although each national money supply changes endogenously with official foreign exchange intervention, the monetary base for the world as a whole still depends on the domestic components of each country's monetary base, $A$ and $A^*$. Without generating net international capital flows, secular rates of growth in $A$ and $SA^*$ could be designed roughly to equal the increase in demand for world money at a constant price level (see my 1974 article). Whereas, random short-run shifts in demand between national monies by private speculators would be fully accommodated by official intervention in the foreign exchanges *without* losing control over the world's money supply.

### B. *Passive Sterilization and Increasing Currency Instability*

Our short-run analysis simply assumed that *ROW* bank intervenes to maintain $S$, the

spot exchange rate. I am not necessarily advocating such intervention, although a carefully delimited case can be made for it (see my 1981 article). More important is to ensure that intensive official intervention of the kind that occurred in the 1970's does not result in further inadvertent losses of international monetary control in the 1980's. Under the workings of the dollar standard, however, foreign official interventions have been conducted so as to leave the supply of dollars relatively unchanged while foreign money supplies—and the weighted world average money supply—have fluctuated erratically (see Table 1).

To demonstrate what happens when sterilization occurs, suppose foreign exchange interventions result in only transitory and negligible changes in $M_r$—deposits of *ROW* bank with the Federal Reserve—such that $M_r \simeq 0$. Instead such deposits are used immediately to buy U.S. Treasury bonds, $B_r$. In practice, foreign central banks from industrial countries hold almost all their foreign exchange reserves in nonmonetary U.S. government bonds or bills as indicated in Table 3. These may be purchased directly with dollar demand deposits in U.S. commercial banks (which are not represented in the model) or the Federal Reserve itself simply acts as a broker by immediately buying U.S. Treasury bonds on account for *ROW* bank in response to incipient increases in $M_r$. Either method results in *sterilization* because the dollar money supply in the hands of the nonbank private sector is insulated from foreign official transactions.[5] It is *passive* because the Federal Reserve is not consciously sterilizing with offsetting changes its own domestic asset position. Rather, the American money supply is insulated from changes in official reserves by the willingness of foreign central banks to hold nonmonetary U.S. government debt.

In contrast, the supply of *rowa* outstanding responds fully to foreign exchange interventions by *ROW* bank. Our assumption of perfect capital mobility ensures that *ROW* bank cannot successfully manipulate $A^*$ to offset these changes.

The equilibrium world money supply arising out of this asymmetrical sterilization procedure can then be calculated by substituting equations (9) and (10) into equation (12) to eliminate $B_r$ in order to get

$$M^w = A/\beta(s). \tag{18}$$

The world money supply now is solely a function of the *domestic* asset position of the Federal Reserve Bank[6] and of the share of dollars in $M^w$; it does not depend at all on the domestic asset position of *ROW* bank.[7] (In contrast, $A^*$ had an equivalent impact on $M^w$ in the nonsterilization case.) Furthermore, the impact of $A$ on world money increases according to the multiplier $1/\beta$. Suppose the U.S. share in world money $\beta$ is decreasing perhaps because the other convertible currencies are becoming more important with fewer exchange controls. Then actions by the Federal Reserve to change $A$ are increasingly magnified in their international impact.

This magnified Federal Reserve multiplier by itself need not lead to a loss of international monetary control. If, in the long run, the Federal Reserve calculates the growth in demand for dollars correctly, that is, $\Delta M = \beta \Delta M_d^w$, and then increases $A$ commensurately, the world's money growth remains determinate and potentially noninflationary. But the system is hardly "fail safe" if the Federal Reserve makes even minor miscalculations regarding the growth in demand for dollars.

In the 1950's and early 1960's under the fixed exchange rates of Bretton Woods, a Federal Reserve policy of passive sterilization of foreign official interventions—coupled with monetary policy based purely domestic indicators—could justifiably be

[5]Anatol Balbach (1978) describes comprehensively how official reserve transactions impinge—or fail to impinge—on the American monetary base.

[6]This result is similar to that of Swoboda (1978), who, however, did not make $\beta$ on endogenous variable that might fluctuate with $s$.

[7]Increases in $A^*$ will result in offsetting decreases in $B_r$ so as to leave the *rowa* money supply unchanged. With $A^*$ fixed, capital flows depend directly on $A$ and $\beta$ according to $dB_r/dA = (1-\beta)/\beta$.

called "benign neglect" of the rest of the world, (see my 1969 article). First $\beta$ was probably close to unity because only a limited number of foreign currencies were convertible on capital account so that the dollar dominated the supply of "international money"; and secondly, exchange rates were —by and large—convincingly fixed so that expected fluctuations leading to international currency substitution were minimal.

However, with managed floating, more volatile exchange-rate expectations, and a secular decline of the share of dollars in world money in the 1970's and 1980's, the old strategy of benign neglect is more questionable. Indeed, differentiating equation (18) with respect to the expected exchange rate change, we have

$$(19) \quad dM^w/ds = (-A/\beta^2)(d\beta/ds) > 0.$$

The supply of world money is now more sensitive to expected changes in exchange rates because $\beta$ has declined, and because the degree of currency substitution $d\beta/ds$ has likely increased. An increase in expected dollar depreciation causes a multiple capital outflow from the United States, a multiple expansion in the *rowa* money supply—but no offsetting contraction in the supply of dollars because of passive sterilization. This is the simple analytics underlying the two explosions in the world money supply in 1971–72 and again in 1977–78 shown in Table 1.

## IV. Policy Implications

Within the context of my simple two-country model of managed floating and perfect capital mobility, the solution to international currency instability is straightforward: the Federal Reserve System should discontinue its policy of passively sterilizing the domestic monetary impact of foreign official interventions. Instead, a symmetrical nonsterilization rule would ensure that each country's money supply mutually adjusts to international currency substitution in the short run, without having official exchange interventions destabilize the world's money supply. Then, long-run monetary control could be secured by coordinated domestic asset expansion by each central bank: increases in $A$ and $A^*$ that match each country's share of world money, and which, together, just satisfy the demand for $M^w$ at an approximately stable international price level.

However, we do not live in a simple two-country world. In reality, *ROW* is a hodgepodge of countries whose governments intervene continually and most hold at least some reserves in U.S. Treasury securities. Only a modest number of the 140 countries in the world have currencies that are convertible on current account, and even fewer extend convertibility to capital account transactions. At most, systematic monetary cooperation with the United States can only extend to a very small inner group: those countries which are sufficiently large and stable to offer monies that significantly compete with dollar cash balances internationally. Elsewhere I have suggested (1974; 1980) that Germany, Japan, and the United States are capable of jointly bringing the world's supply of convertible money under control through a mutual nonsterilization pact *and* agreed-on rates of domestic credit expansion by each of the three central banks. In acting optimally under a continuing world dollar standard, this triumvirate would still follow a monetary policy of benign neglect (passive sterilization) with respect to dollar interventions by other countries.[8]

A critic might well argue that a more basic problem is "dirty" floating: the continued propensity of central banks to intervene directly despite the absence of official par value obligations. If the governments of industrial

[8]Consider one further caveat to even this partial solution for stabilizing the world's supply of money. Our two-country theoretical model assumed perfect capital mobility. Yet we know that both the German and Japanese authorities have imposed controls on capital movements from time to time. In the presence of current account surpluses or deficits (which was not present in the analytical model presented above), sterilization by the Bundesbank or Bank of Japan may be justified insofar as either is simply acting as an international financial intermediary because normal flows of private capital have been disrupted. Rescinding the assumption of "perfect" capital mobility, however, requires a more elaborate analytical model yet to be developed.

countries agreed not to intervene at all in the foreign exchanges, and if each followed fixed domestic monetary growth rules, control over the world's money supply would be secured automatically. Such a nonintervention agreement would seem easier to negotiate than a nonsterilization pact.

Unfortunately, the noninterventionalist solution implicity presumes that the demand for each national money is stable. But governments in increasingly open economies are unable to risk prolonged upward or downward movements in their currencies (particularly against the dollar) because of 1) the possibility of cumulative currency substitution in favor or against the national currency (Table 1); and 2) the unsettling direct effects that major exchange-rate movements have on the domestic economy. For a fiat money without intrinsic value, the direct stabilization of its international purchasing power in the short run may be viewed (possibly correctly) as an important first line of defence in stabilizing its domestic purchasing power in the longer run.

Even in the United States itself, which is a huge relatively closed economy, expected dollar depreciation and international currency substitution in 1971–72 and again in 1977–78 substantially reduced the demand for dollars. Measured growth in American *M*1 thus seriously understated the degree of inflationary pressure in the system—pressure that was more accurately reflected in the "world" money supply series appearing in Table 1. The doctrine of "domestic monetarism," where the Federal Reserve System keys on some purely American monetary aggregate such as *M*1 or *M*2 and ignores the foreign exchanges, is increasingly inefficient for preventing global inflation or deflation—and for stabilizing American income and prices.[9]

[9]The doctrine of "domestic Keynesianism," where the government keys on some domestic nominal rate of interest (possibly insulated from the international economy by exchange controls), is likely to be even more inadequate (see my 1979 book and my 1980 article). However, a full treatment of the Keynesian approach requires an analysis of open-economy fiscal policy under the world dollar standard. That is a story for another time.

## V. Addendum: The Great Deflation of 1981–82

Over 1980–81, money growth (*M*1) slowed down more drastically in Germany, Japan and Switzerland—countries providing substitute international reserve currencies to the dollar–than did growth in American *M*1*B*. True to its doctrine of domestic monetarism, the Federal Reserve System chose to ignore this monetary contraction occurring abroad.

What forced the Swiss, German, and Japanese central banks to let their monetary growth rates fall so sharply? World monetary demand shifted sharply away from their monies (and that of several other smaller countries) towards dollars. On the positive side, it became likely in 1980 that a new "free-market" government would be elected in the United States which would have much lower inflation targets. And there was political turmoil in Europe: the threat in Poland of a Russian invasion and the election in France of a socialist government predisposed to expropriate private wealth. The dollar—previously battered in 1977–78—surged upward on the world's foreign exchange markets in 1980–81 and on into 1982. After watching their currencies depreciate quite sharply, these three central banks entered to prevent further price-level disalignment by selling dollars and repurchasing their own currencies thus contracting that part of world money (*M*1) denominated in Swiss francs, marks, and yen. There was no automatic offsetting expansion in the American monetary base to accommodate the increased demand for dollars, because of the passive sterlization associated with the normal operations of the world dollar standard.

Thus has speculation in favor of the dollar in 1980–81 imposed unduly sharp deflation on the world economy, just as speculation against the dollar in 1971–72 and again in 1977–78 fueled the two great inflations of the 1970's.

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